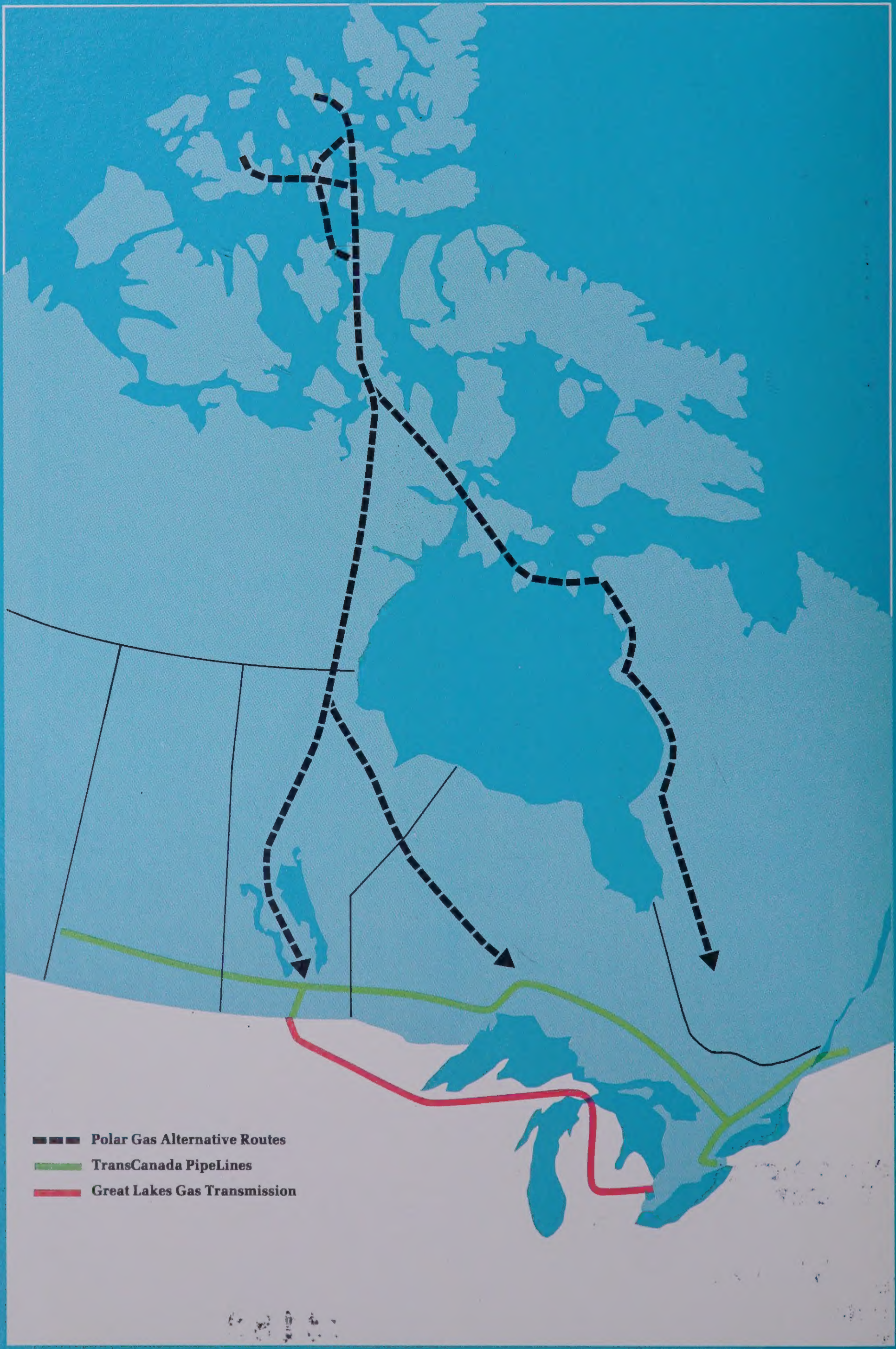
# polargas

# An Arctic Islands Gas Pipeline

POLAR
PAM
4211
POLARPAM

Pam 621.644:(*41N)/PGP


Polar Gas Alternative Routes
TransCanada PipeLines
Great Lakes Gas Transmission

# An Arctic Islands Gas Pipeline/Why?

**Canada needs new energy.** Natural gas, for example, is a prime source of energy for heat and power. But conventional sources of natural gas cannot meet our current needs and provide for projected growth in demand. Other readily-available sources of energy are also at a premium. In fact, forecasts are that Canada will become a substantial net importer of crude oil by the early 1980's.

Over the next few years, natural gas discovered in Canada's northern frontier areas will be called upon to fill a larger role in meeting Canada's energy requirements – both in serving traditional gas markets and in replacing other less economically or environmentally attractive energy sources.

And the gas is there. On the basis of geologic forecasts and substantial discoveries already made, the Arctic Islands appear to hold the greatest potential for development of any frontier area.

Stated simply, Arctic Islands gas is needed now. And it will continue to be required for the foreseeable future. By far the most economical and efficient means of gaining access to this secure supply of low-cost energy is a large diameter pipeline system.

BOREAL INSTITUTE
LIBRARY

Rec'd: MAR 11 1976
Order No.:
Price: Free
Acc. No.: Polar gas

22182

(Above) During the summer program, launches were one means used to collect bathymetric data.

(Right) A current meter is recovered by researchers on board the main summer survey vessel *Percy M. Crosbie*.

# What has been accomplished?

The Polar Gas Project was formed in late 1972 with the aim of investigating the feasibility of a transportation system to connect high Arctic gas reserves, discovered by Panarctic Oils Ltd. and other companies, to waiting markets in the South.

The mandate for Polar Gas researchers was to develop a viable means of economically moving trillions of cubic feet of Arctic Islands natural gas over 2,000 miles to the South without seriously damaging social or biophysical environments.

Because of its higher throughput and lower unit costs, a pipeline emerged early in the investigations as the most attractive transportation option.

A great deal of Canadian and international experience had already been gained in land pipelaying during the winter – and across rock and frozen muskeg conditions similar to those encountered along a major portion of the Polar Gas routes. Test facilities had also been constructed in the Arctic to demonstrate that a chilled, buried pipeline could be operated without damage to permafrost terrain.

Construction of marine inter-island pipeline crossings, however, represented a substantial technical challenge, particularly because these deepwater channels can be ice covered for as much as fifty weeks of the year and conventional laybarge operations did not appear to be a feasible construction method.

As a solution, Polar Gas engineers proposed a unique new approach to pipelaying – installing the pipeline across the ice-covered channels during a

The Polar Gas camp at Rea Point, Melville Island (foreground) —base of operations for high Arctic field programs.

(Right) A modified pipeline ditcher proved that it will be possible to cut a trench through the thick Arctic ice.

(Below) A 30-mile trench, essential to pipelaying from the ice, was cut across Austin Channel.

three-month winter construction season, using the ice as an extension of the land surface whenever possible.

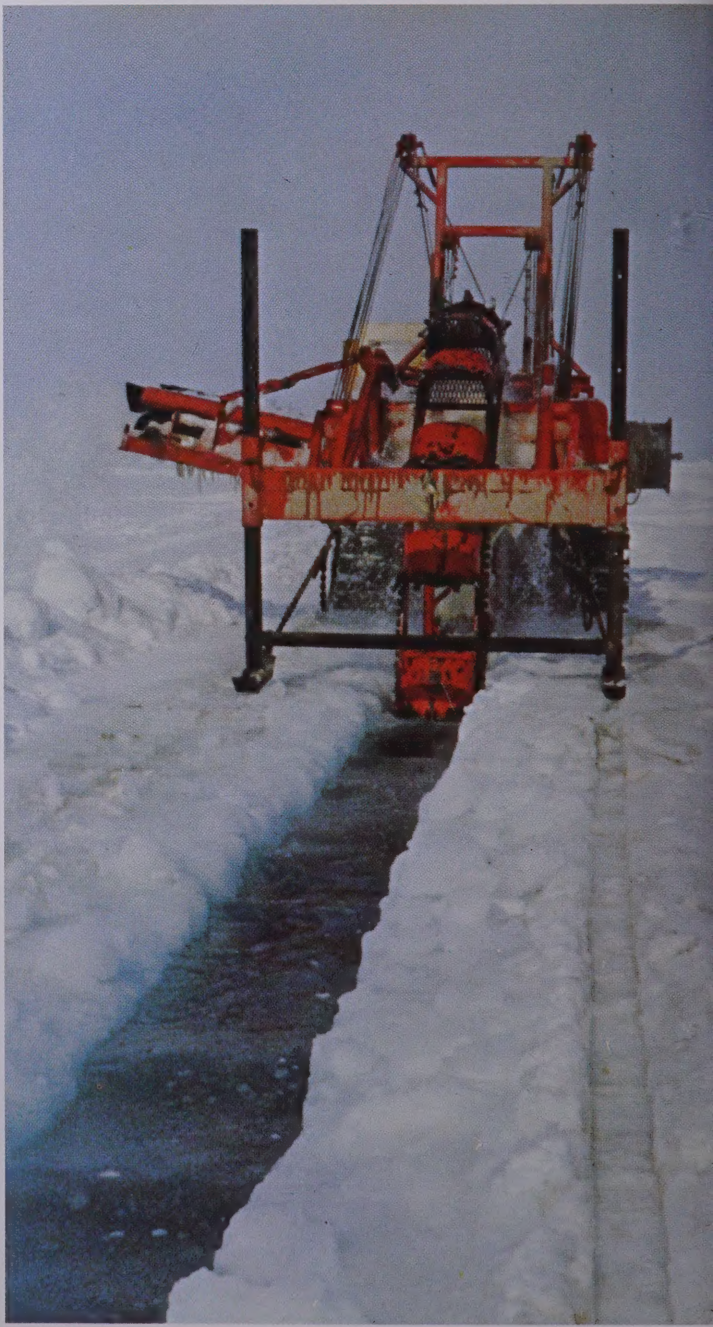
### Initial Research

The first year of research was largely devoted to an analysis of the conditions in Arctic channels that could affect the design of pipelaying systems – from the depths, currents and bottom composition and profiles . . . to the thickness, strength and stability of the ice surface . . . to the potential for iceberg "scour".

Between March and June of 1973, researchers operated from a permanent base camp established at Rea Point on the southeast corner of Melville Island. Continuing the search for information, a subsequent summer marine program was carried out from the decks of an ice-strengthened vessel the *Percy M. Crosbie.*

In anticipation of the program's findings, parallel work was going on throughout the year in offices in the South to establish basic design concepts – using, wherever possible, extensions of existing marine pipelaying technology.

Rounding out the year's program, Polar Gas carried out a preliminary environmental study to identify future research needs, and completed an aerial photographic survey along over six thousand miles of potential route corridors.



(Above) Ice augers, along with electronic profilers, were used to measure the thickness of the ice platform.

(Left) An Inuit field worker uses a chain saw to cut through the ice.

## Further work

The 1974 Polar Gas research program entailed further office studies and field work in the Arctic Islands, building on the results obtained the previous year.

Initial investigations had shown, for example, that the bathymetric conditions in the channels presented no major problems and that areas of the channel bottoms subject to iceberg "scour" were at sufficiently shallow depths to permit the pipe to be protected in a shoreline trench or tunnel.

And where the 1973 program had proven that, in general, the Arctic ice surface would sustain the weight and other stresses of construction equipment required for pipelaying operations, it had also confirmed that ice in the channels was not of a completely uniform thickness. Researchers therefore set out in 1974 to establish that, where necessary, the ice surface could quite easily be artificially thickened to provide extra strength.

Working from an expanded camp at Rea Point, Polar Gas scientists used a newly developed through-the-ice technique to gather further data on channel depths and bottom contours required to establish acceptable crossing routes in the Arctic Islands.

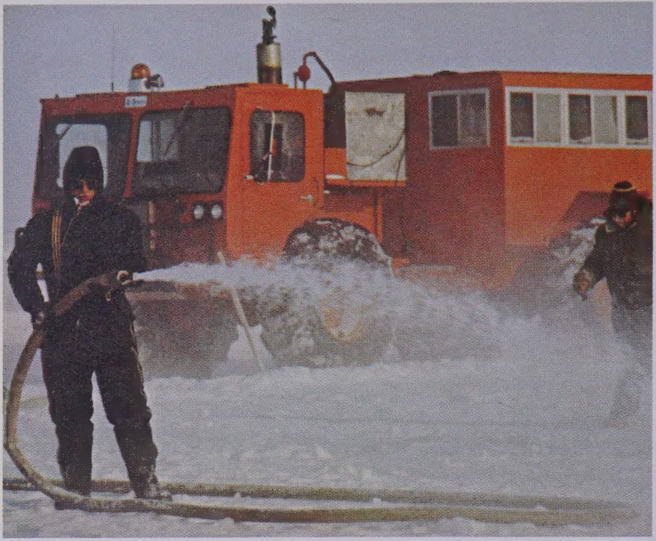
Design work on pipelaying systems continued during the year and, while a number of alternatives remained under active consideration, those based on the established "bottom pull" technique appeared to be the most cost-effective methods.

Environmental research programs moved to the field for the first time in the summer of 1974, with researchers carrying out a wide variety of biophysical studies in the high Arctic north of Spence Bay.

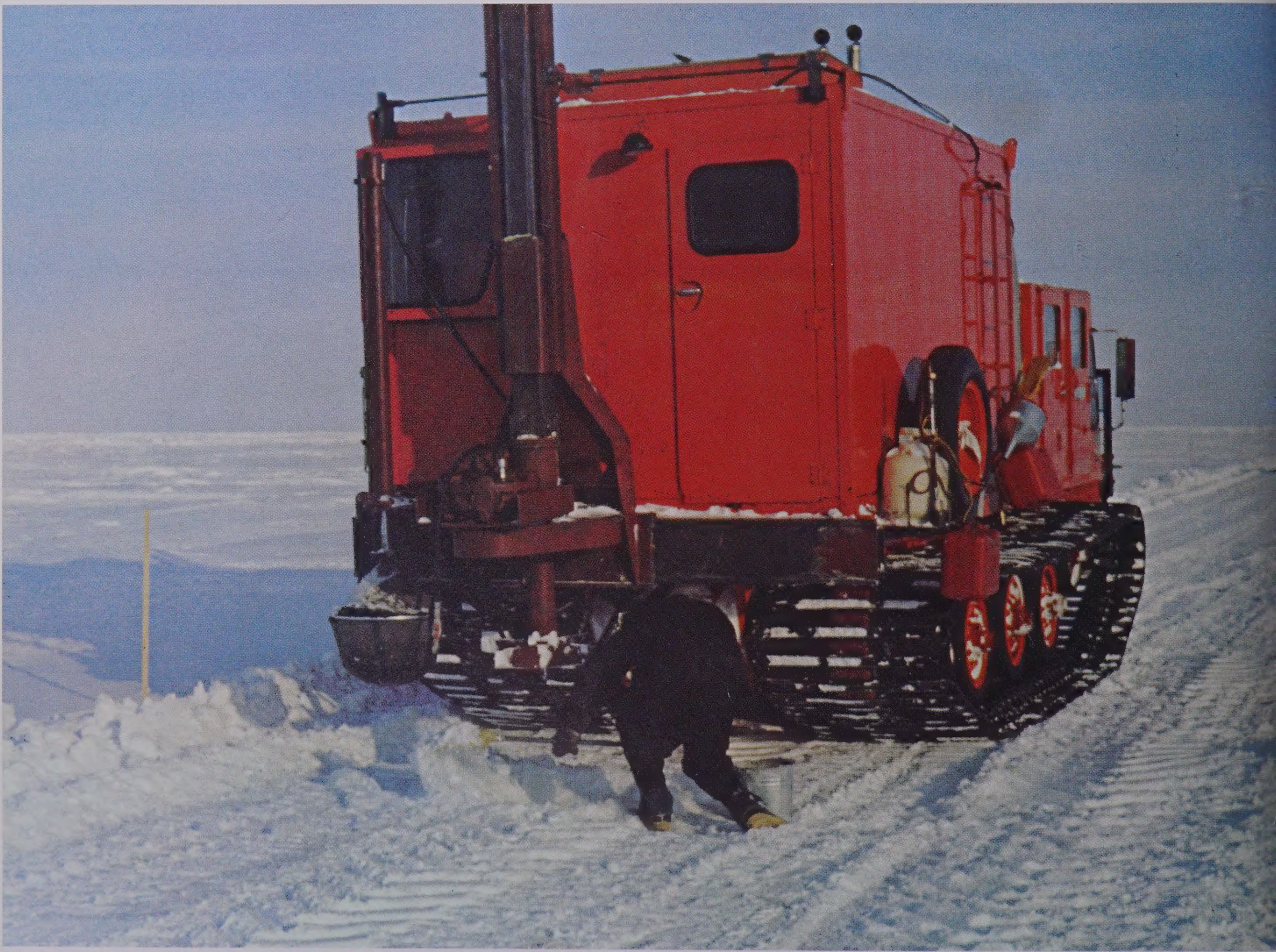
A smaller ditcher was used to cut trenches required for tests designed to measure strength and elasticity of the ice.

(Left and below) As a first step in plotting the bottom contours of Arctic channel crossings, readings were taken using a "through-the-ice" profiling system developed for Polar Gas.

Results from a variety of ice studies, including these tank and cantilever tests (above), have been incorporated into a computer program to allow prediction of the load bearing capacity of an ice sheet.

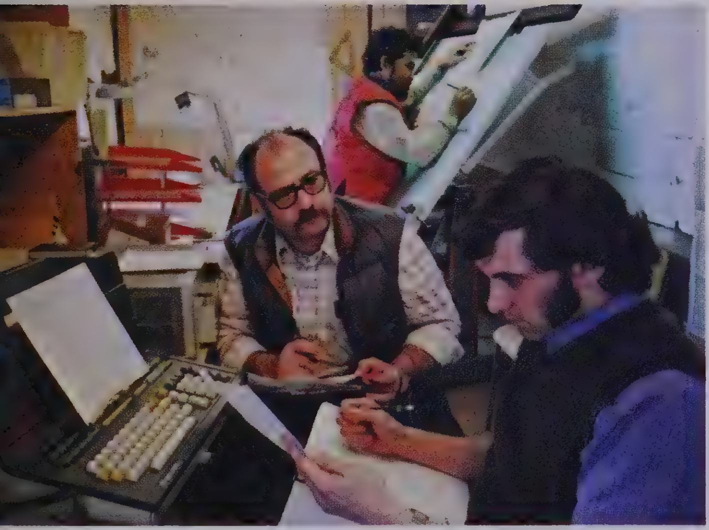


(Right) Flooding tests established that, where necessary for pipelaying operations, artificial ice platforms can be built. (Further right) Test plots of thickened ice seen from the air.



Once a preliminary crossing route had been selected by the helicopter team, a complete profile of the channel bottom was obtained using the "through-the-ice" system mounted in a tracked vehicle. Overlapping readings were taken at 15-meter intervals.

(Below) To gauge currents and tides, an important factor in pipelaying design, current meters were lowered from the surface of the ice.



In establishing "acceptable" routes across channels, computerized analysis and plotting of the crossing profiles was done within the Polar Gas Rea Point camp.

## Current programs

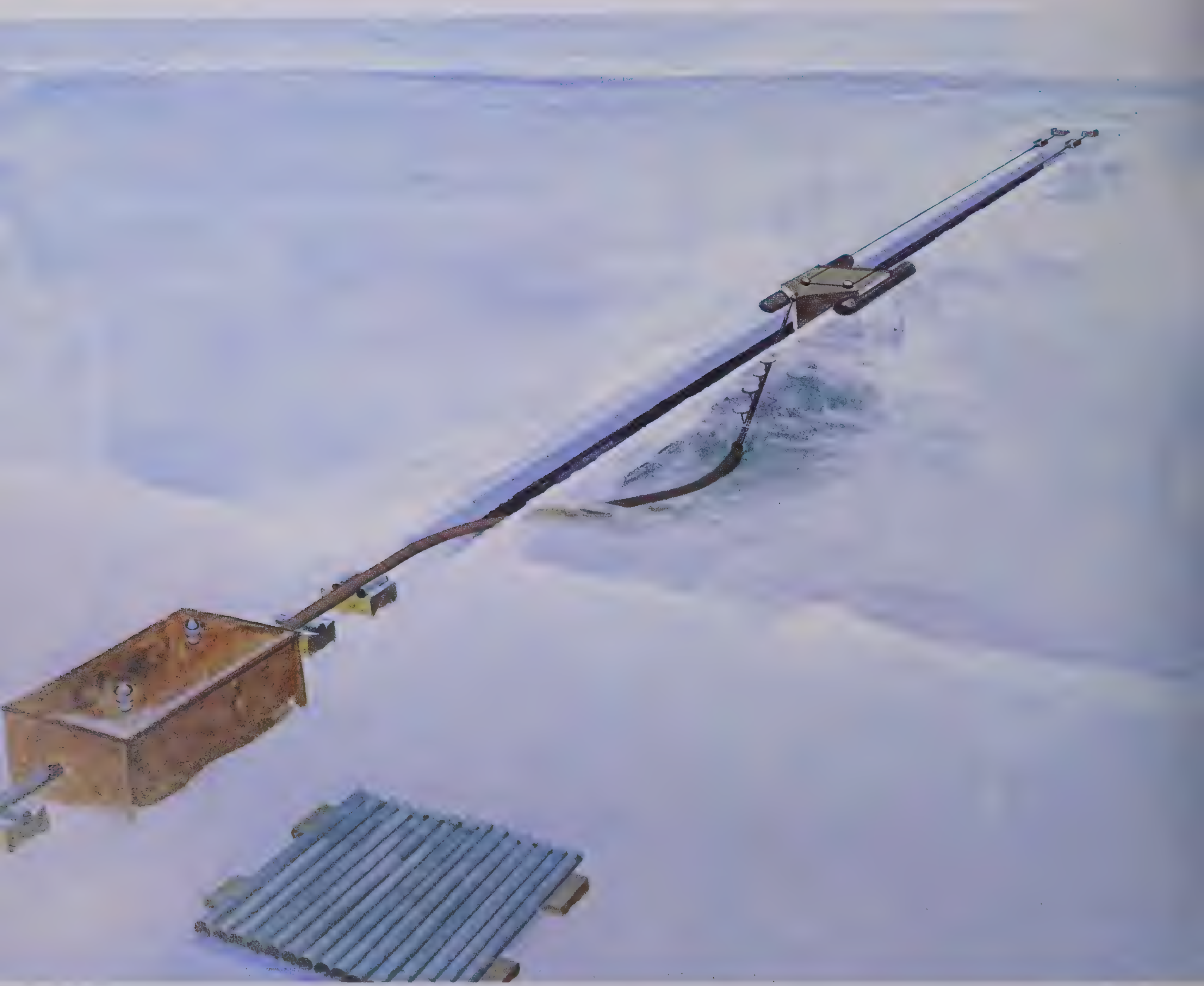
With basic engineering field research work now virtually completed, efforts are now being concentrated on evaluating the mass of data collected during previous years and on applying this information to the selection of a preferred construction technique for each of the channel crossings to be faced in moving Arctic Islands gas to the Boothia Peninsula.

Environmental field programs – including, for the first time, studies designed to produce an analysis of the socio-economic impact of the pipeline – have been extended southward to include all relevant areas from Melville Island to sixty degrees north latitude on the west side of Hudson Bay.

## Results to date

In general, research and design work carried out since 1973 has shown that a natural gas pipeline from the Arctic Islands is technically and environmentally feasible. Economic analyses have demonstrated that the cost of energy transported by such a system would be competitive with any comparable energy source.

# How will the channels be crossed?



A simplified schematic drawing of the "bottom pull through-the-ice" system (not to scale). A number of other pipeline installation methods are also under consideration. In actual construction, pipe would be protected at the shoreline from "ice scour" in a trench or tunnel.

The "bottom pull" technique has been widely used by pipeline contractors around the world. (Above) Pipe is "strung" at the shoreline before construction of the pipeline crossing of the straits of Mackinac. (Top) An array of pull cables.

Depending on the width, depth, ice conditions and other characteristics of the channels to be crossed, a number of pipelaying methods could be required. In general, however, they fall into two basic categories: those using the ice as a platform from which to lower the pipe (somewhat in the manner of a lay barge) . . . and those based on the conventional "bottom pull" technique – either from the ice surface or directly from one shore to the other. An additional option for one of the channels under consideration is to construct the pipeline crossings using a ship to pull the pipe during the summer season.

As currently conceived, the "bottom pull through-the-ice" system (shown at left) would involve the building up of artificially thickened ice platforms or "ice islands" from which winches would pull the pipe assembled on shore. This method could require one or more "tie-ins" or welds to connect long sections of pipe which have been pulled into position. The technology to carry out mid-channel "tie-ins" is readily available and adaptable to Arctic conditions.

On shorter channel crossings the "bottom pull shore-to-shore" technique would entail one pulling station on land pulling the pipe under the ice from the opposite shore.

To ensure continuity of service and to minimize the size of pipe involved in constructing the crossings, multiple smaller diameter pipelines would be constructed across each of the channels.

# Will the environment be protected?

Only by undertaking studies to determine the extent to which a pipeline will affect the natural environment of the North will it be possible to plan, design, construct and operate a pipeline in a manner that will cause the least possible amount of ecological disturbance.

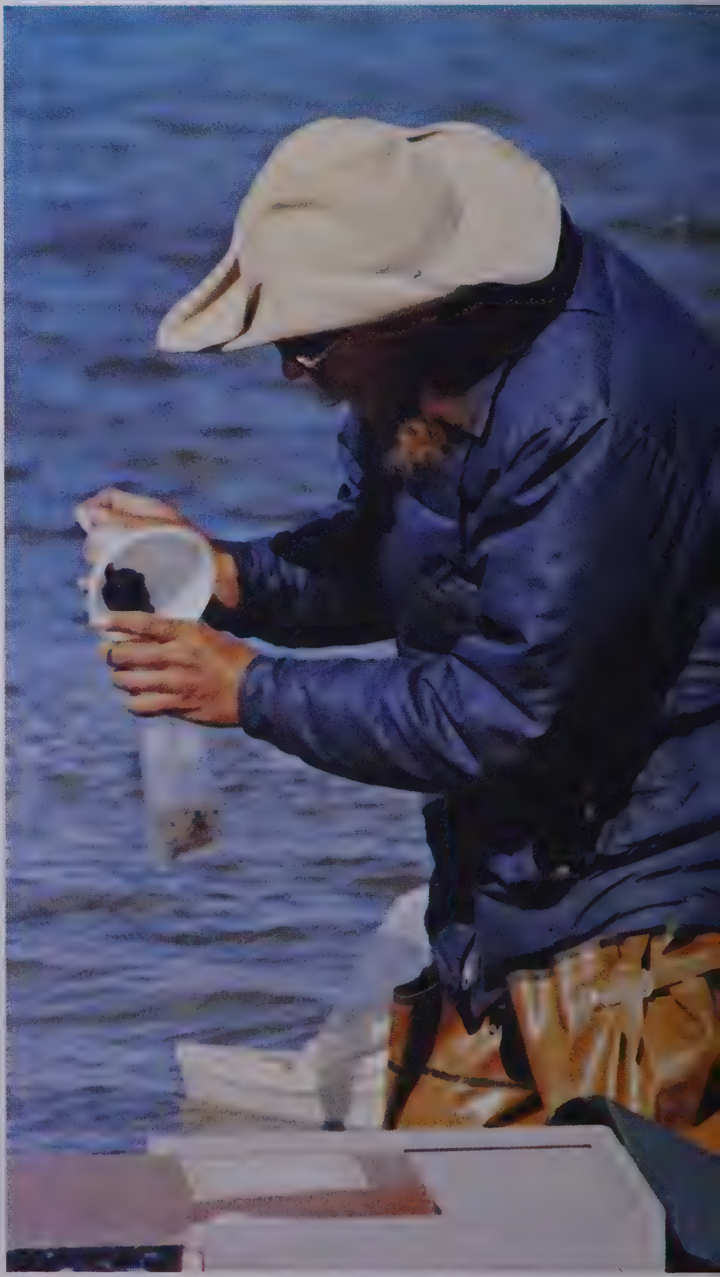
With this in mind, Polar Gas is carrying out a broad program of biophysical research, on both land and water, designed to gather information required. The program is divided into five major disciplinary areas: landscape and reclamation, mammalogy, ornithology, freshwater fisheries and marine ecology.

In carrying out the work, Polar Gas consultants are using a combination of broad-based aerial surveys and detailed ground or oceanographic studies – to provide wide coverage and yet allow a full assessment of the relative importance of specific areas.

Environmental research is already confirming that the regions along the proposed route above the 60th parallel are, for the most part, very low in biological productivity. In fact, in many areas of the Arctic Islands less than five per cent of the ground is covered with vegetation. As a result, the relatively small areas of greater productivity are most important and receive study priority.

Where areas important to wildlife cannot be avoided through route selection, impact can often be minimized by the scheduling of activities. Birds, for example, are only present in the Arctic during a short summer season and can be avoided by confining construction programs to other times of the year.

In the same way, conflict with fish can be minimized by staging stream and river crossing ac-



Collection and analysis of bottom sediments is an important part of studies of rivers and streams.

(Left) While areas above the 60th parallel are not biologically productive, vegetation which does exist must be protected.

An ornithologist prepares to note a bird sighting.

Geomet probes are installed in areas of continuous and discontinuous permafrost to measure ground temperatures at different depths.

tivities in the Winter – when many watercourses are frozen to the bottom. On the other hand, identifying and avoiding areas of unfrozen water is crucial in that these represent the only locations in which fish can survive Arctic winters.

By preserving fish and wildlife, environmental protection planning acts in the interest of the local people who often depend on these resources, at least in part, as a source of food.

While the areas of the North through which the pipeline would pass are not heavily populated, protection of social environments is a critical consideration. Because of this, Polar Gas is conducting a related socio-economic research program attempting to gather information on the human environment in those areas which would be within the sphere of influence of a pipeline.

The program is intended to first develop an understanding of the history and culture of the North and to relate this knowledge to the current situation – so developing a socio-economic baseline against which the impact of the pipeline can be measured. The program is also charged with developing policies which will minimize any potentially detrimental effects of the pipeline and maximize any positive impact.

Before permission to build a pipeline can be granted, Polar Gas will be required to show that it has taken every reasonable step to insulate Northern residents from potentially disruptive influences and provided that these same residents will profit to the greatest degree possible from the construction and operation of the line.

(Top) A botanist examines an Arctic wildflower. Programs attempt to establish a relationship between land, vegetation and animals.

(Above) Fisheries researchers must identify locations in which fish overwinter in the Arctic to ensure these areas will not be disturbed by construction activities.

(Top) A geomorphologist measures depth of the permafrost and examines soil types as part of landscape and reclamation studies.

(Above) Impact on wildlife such as this muskox can be minimized through both route selection and scheduling of construction activities.

# What about the Northern people?

Throughout the research, construction and operational phases of the pipeline, it is the intent of Polar Gas to keep Northern residents informed, and to the extent possible, involved in the Project and its work.

Critical to this effort is communication... listening to concerns and ideas – taking advantage of the vast amount of knowledge which exists in the minds of the people of the North... speaking plainly and honestly – keeping Northerners aware of both plans and programs and their implications.

Long before the regulatory period, Northerners will have made their voices heard to Polar Gas in a number of ways: talking with representatives who visit communities regularly, as employees assisting in carrying out field studies and as consultants independently carrying out relevant research programs funded by the Project.

In the longer term, training programs will permit residents of the North to pursue careers as skilled workers and managers in the construction and operation of the pipeline.

For its part, Polar Gas will attempt to make the people of the North aware of the Project – what it is, what it could mean for them and why it is in the interest of all the people of Canada.

polargas

## FACT SHEET

| | |
|---|---|
| PARTICIPANTS: | TransCanada PipeLines (Project Manager)<br>Panarctic Oils Ltd.<br>Tenneco Oil of Canada Ltd.<br>Pacific Lighting Gas Development Company<br>Ontario Energy Corporation<br>Petro-Canada |
| FORMATION DATE: | November, 1972 |
| PROJECT AIM: | To investigate the feasibility of a natural gas pipeline or other modes of transmission to transport natural gas from the Arctic Islands to southern markets |
| REQUIRED RESERVES FOR PIPELINE: | 20-30 trillion cubic feet |
| RESERVES TO DATE: | 12 trillion cubic feet |
| PIPELINE LENGTH: | 2,200 to 3,200 miles (depending on routing) |
| PIPE DIAMETER: | 42"-48" land lines<br>up to 36" marine crossings |
| SYSTEM THROUGHPUT | |
| MINIMUM: | 2-3 billion cubic feet per day |
| ULTIMATE: | 3.5-4.5 billion cubic feet per day |
| ESTIMATED CAPITAL REQUIREMENT: | $4.5-$7.5 billion (1974 dollars) |

February, 1976

BOREAL INSTITUTE
LIBRARY
22182

Date Due

FEB 17 '77

22182
4211
Polar Gas.
An arctic islands
ALP 6
APR '84

22182

BOREAL INSTITUTE
FOR NORTHERN STUDIES LIBRARY

THE UNIVERSITY OF ALBERTA
EDMONTON, ALBERTA. T6G 2E9

polargas

Polar Gas Project
P.O. Box 90
Commerce Court West
Toronto, Ontario
M5L 1H3

La présente brochure est également
disponible en français

ᑕᓇ ᐅᑲᓕᒪᒐᒃ ᐃᓄᒃᑎᑐᑦ ᑕᐅᓯᒪᒥᔪᒃ

University of Alberta Library
0 1620 0335 6548

polargas